Biol

The Oyster And The Oyster Industry of Maryland

BY

REGINALD V. TRUITT

Biologist, Conservation Department of Maryland and Professor of Aquiculture, University of Maryland, College Park, Md.

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FOREWORD

The oyster industry ranks foremost among the seafoods of the world; and in Maryland ("the paramount fisheries state,") it exceeds in value, by far, any other industry founded upon marine or fresh-water forms. The oyster's life-history and the facts concerned with the management of the industry are not easily understandable, though the fishermen and the average consumer take for granted that Nature, in a simple fashion, creates this interesting denizen of our valued Chesapeake Bay. Constant requests come to the Department of Conservation for comprehensive information about this mollusk, its value as a natural asset, and the potentialities of the Chesapeake Bay whose oyster bars have suffered great depletion in years gone by. To supply the sought-for information, and at the same time contribute to a better understanding on the part of the public, we took pleasure in asking the author of this publication to present the facts.

Dr. Truitt has acted as Department Biologist, without pay, for the past ten years, and in that period has assiduously studied and investigated the oyster and the oyster industry of Maryland. His work in that time has carried him to almost every important oyster-producing area in America. His contributions to the field of marine biology are too well known to need comment here, nor need we point out that he holds a professorship in aquiculture at the University of Maryland as well as the acting directorship of the Chesapeake Biological Laboratory. Dr. Truitt was born in an oyster-producing community, has a direct interest in a firm of oyster dealers, and takes an active interest in producing oysters on a profitable farming basis in Sinepuxent Bay.

The Conservation Department of Maryland takes pleasure in publishing this bulletin which is to be followed by another by the Commissioner, dealing with the more purely economic aspects of the oyster industry, past and present, its management, policies for enhancement and similarly pertinent facts.

SWEPSON EARLE, Commissioner of Conservation.

The Oyster and the Oyster Industry of Maryland

By R. V. Truitt,
Professor of Aquiculture, University of Maryland, and the Director of the Chesapeake Biological Laboratory

INTRODUCTION

Just when oysters became objects of economic interest is not known, but records of their being included in the human diet indicate that they were very commonly used and highly prized by the Romans. Pliny the Elder, nearly nineteen hundred years ago, told of their abundance in the Adriatic Sea, while Sallust, after his trip with Caesar to what is now England, said that he could find only one good in the Britons; "they eat oysters." In America, the Aborigines used oysters in great quantities long before the white settlers found them drying this product for exchange purposes with the more interior dwellers. Indeed, in Maryland there are in many places piles of shells, small when compared with more northern mounds, containing thousands of bushels, inland as well as in the tidewater regions, which were made by Indians and today stand as testimony to the vast quantities of oysters used by the tribes.

The oyster industry is the most valuable fishery of the United States, and is questionably second to any other world-wide. In Maryland the industry exceeds, by far, other aquicultural resources and is paramount in the Chesapeake Bay. In all branches of the industry state-wide, over ten thousand citizens are employed directly each year, while, indirectly, upward of two thousand others are connected with it. Considering the workers and those depending upon them, the contribution of the oyster industry to the welfare of the citizens of the State is impressive.

Oyster production, during late years, reaches approximately two millions of bushels per annum. The world's yearly output of oysters extends, it has been estimated, up to or above twenty-five

millions of bushels, the greater part of which quantity is produced in America; it being indicated that the waters of the United States, alone, are producing approximately eighteen millions of bushels. In monetary terms the industry brings to Maryland, annually, over three million dollars, while it is estimated, in the absence of carefully gathered statistics, that the crop, world-wide, is worth upward of twenty million dollars. The shells from oysters in Maryland, formerly without commercial use, now add an annual income to the industry of some one hundred and fifty thousand dollars, and give rise to still another industry, that of chick-grit and lime production. The market for this chick-grit is a strong one in Europe as well as in America.

While the oyster industry reaches its greatest proportions in the United States it is by no means confined to their borders. Oysters are found on practically every coast throughout the world, where temperatures range to seventy degrees Fahrenheit and above, though many countries possessing great beds have done little or nothing to develop and use them. In order of importance of the industry this bivalve is produced in the following foreign countries: France, England, Holland, China, Japan, India, Ireland, and New South Wales. At least six other European countries, and fifteen elsewhere in the world, produce oysters and consume them, although not in sufficient quantities as to be of great economic interest. Thus, while not all of the same species, it is seen that oysters are widely distributed marine animals upon which industries have been developed; for the most part animals produced without cultural methods, simply taken from their habitat in the fashion of gathering wild fruit.

From the time of the planting of the colony at St. Mary's City, oysters have been a dependable source of food for people living along Maryland's tidewater. There was, apparently, no industry in the State until early in the nineteenth century when, with the development of such nearby cities as Philadelphia, Baltimore, and Washington, there sprang up a demand for oysters which resulted in the perfection of devices for the capture, special boats for the operations and highly skilled men to conduct the work. By 1840 the industry had developed to a point that attracted attention in this country and abroad. However, the peak of production in Maryland's oyster industry was not reached until in the

decade of 1880-1890, when in a single year more than fifteen million bushels* were produced. Because of the ever increasing harvest watermen had come to feel, by this time, that the oyster resources of the Chesapeake were inexhaustible. Since that period, however, there has been a gradual diminution in the supply, with an occasional favorable year, albeit, until the present low level has been reached. With the production of less than three million bushels last year, there is thrown down a challenge to the best in science and in practice to check the depletion and effect restoration.

* According to Dr. W. K. Brooks of the Johns Hopkins University who made biological and economic studies of the Chesapeake oyster during the decade in question. The Oyster, Brooks, W. K., 1905—Johns Hopkins Press, Baltimore.

BIOLOGY OF THE OYSTER

Contrary to the opinion generally held, the oyster, a sedentary creature, is a highly evolved form, having well developed systems for digestion, circulation, respiration, response to stimuli, and reproduction. The species, *Ostrea virginica* Gmelin, upon which Maryland's industry is founded is indigenous over a wide range of territory extending from the Gulf of St. Lawrence, in Canada, to the Gulf of Mexico, nearly as far down as Vera Cruz. The most prolific areas in its habitat, for the most part in sounds, bays and lower sections of rivers, range from Connecticut southward, the Chesapeake Bay waters being by far the most productive.

Food and Feeding

For food oysters use, apart from a small amount of plant detritus, microscopic particles of living matter termed plancton and nanaplancton, the latter being even smaller organisms than the former. These particles are animals and plants of a low order, largely single-celled, which thrive prodigiously in saline waters, and especially in those of the Chesapeake. Just why this body of water is so very rich in such forms can be better understood when it is recalled that all animals depend upon plants for food, directly or indirectly, and that plants, only, have the power of synthesizing inorganic substances into proteins, carbohydrates, and fats, which are the foods consumed by animals. Pure water cannot sustain life, because of the absence of available inorganic substances for purposes of food manufacture. However, natural waters are never pure, for water, the greatest solvent known, readily takes gasses and solids into solution from the air and soil, carries them to the bays and oceans, thus accounting for, among other things, the salt of the sea.

The Chesapeake Bay, through its great system of tributaries, is ideally situated with reference to watershed, being a drainage basin for the greater part of Pennsylvania, New York, Maryland, Virginia, and Delaware. That is to say, the excess water that

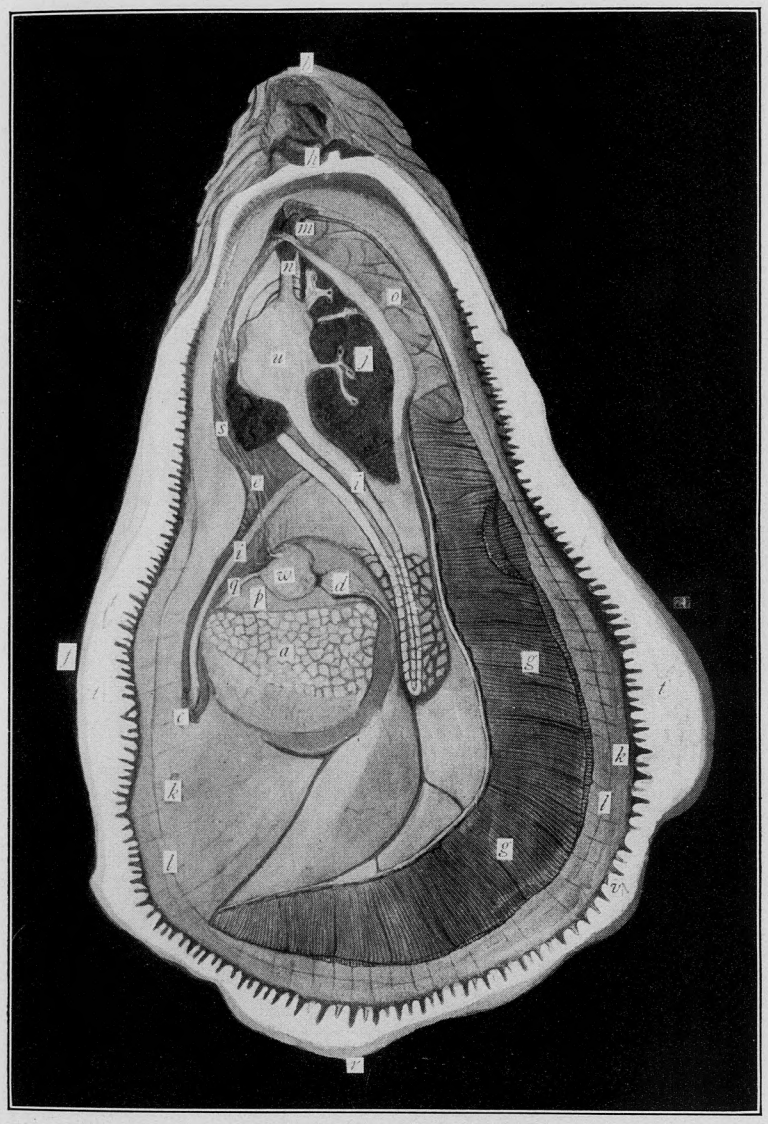

FIGURE NO. 1. SEMIDIAGRAMATIC SKETCH OF AN OYSTER SHOWING ITS ANATOMY:

a, Adductor muscle; *b*, Anterior end; *c*, Anus; *d*, Auricle; *e*, Anterior oarta; *f*, Dorsal aspect; *g*, Gills; *h*, Hinge ligament; *i*, Intestine; *j*, Liver; *k*, Mantle; *l*, Nerve; *m*, Mouth; *n*, Oesophagus; *o*, Palps; *p*, Pericardial cavity; *q*, Posterior aorta; *r*, Posterior end; *s*, Reproductive glands; *t*, Shell; *u*, Stomach; *v*, Tentacle; *w*, Ventricle; *x*, Ventral aspect.

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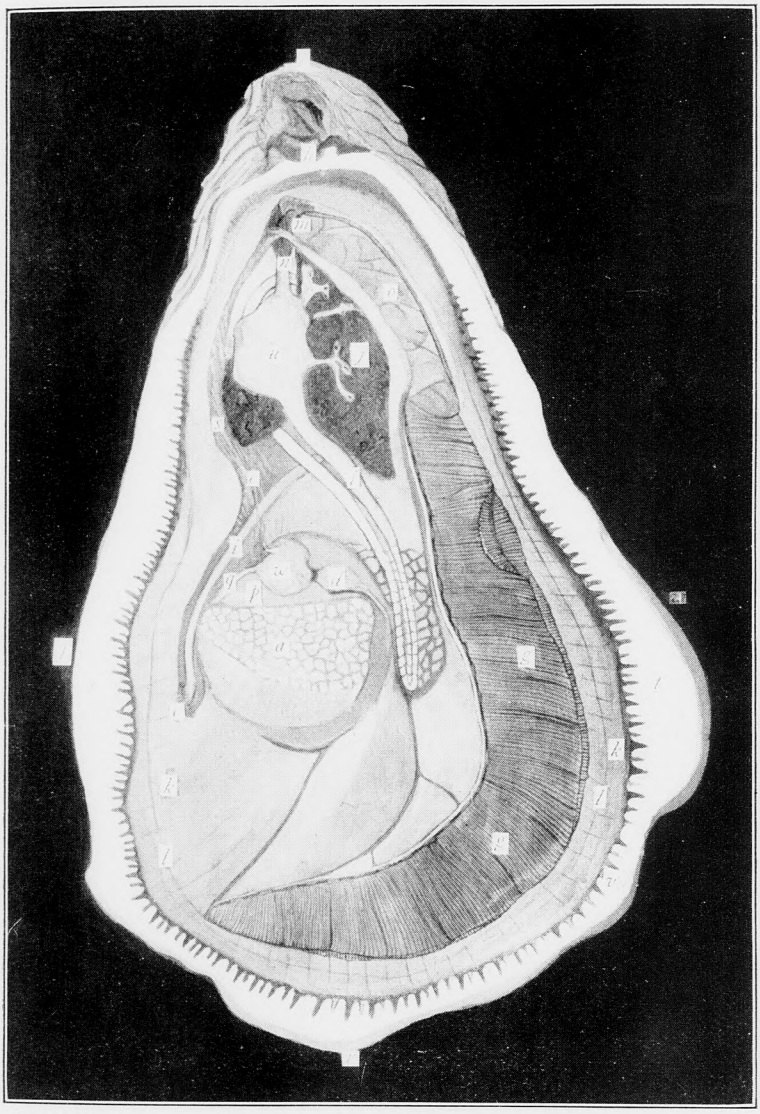

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falls on some one hundred and thirty-five thousand square miles of rich land finds its way to the Chesapeake, carrying with it valuable inorganic substances, dissolved from the soil, to enrich the water and make possible the luxuriant vegetable and subsequent animal life found therein.

The oyster is highly modified to gather the microörganisms produced in the water. Its respiratory organs (See Figure No. 1), four fringe-like gills on the ventral and posterior surfaces, are covered with cilia, delicate hair-like processes, which beat somewhat in wave fashion and assist in gathering the food particles. Secretions from these same gills entangle the organisms which, by means of the cilia, are passed forward to the palps or lips, in the immediate region of the mouth. By this time considerable selection has taken place and most of the non-food substances, such as mud particles and fine debris, have been discarded. By creating currents of water over and through the gills the cilia not only assists in securing food for the oyster and transporting it to the mouth, but, at the same time, they maintain a flow of oxygen-laden water for respiratory purposes, as well as remove wastes that are freely discharged through the gills. During the active seasons an average size oyster may pump eight or ten gallons of water through its gills each day. Obviously, an organ which pumps water, collects food, transports food, secretes, excretes, and acts as a gill, is complicated. Oyster gills do all these things effectively.

Food enters the mouth which, contrary to the opinion generally held, is located near the hinge of the shells, or anteriorly. From the mouth the food is led to the stomach, a comparatively spacious organ, through a short tube, the esophagus. Digestive juices secreted by the folds of the stomach and by a massive gland, usually very dark in color and known as the liver, which surrounds the stomach, are thrown into the digestive tract. Here, aided by the crystalline style, a uniquely constructed body that disappears some minutes after oysters are removed from water, amber colored and rather eel-shaped, lying unattached in the system, they break down and digest the food, so as to permit its diffusion and distribution throughout the body. Digestion is completed and absorption takes place for the most part in the intestine, a long tube which runs posteriorly and ventrally to a

point opposite the heavy muscle (adductor), whence it bends back upon itself passing anteriorly and dorsally (see Figure No. 1) around the stomach, by the esophagus, and again posteriorly on to the external orifice, the anus, located on the dorsal surface above the posterior edge of the adductor muscle. Non-digestible matter is voided through this opening as in animals of higher types.

Respiration and Circulation

As in the case of the absorption of oxygen in the gills and subsequent distribution of that gas to all parts of the oyster's body, the blood system takes up the digested foods and delivers them to the tissues of the animal. This system, while not completely closed as are those of mammalian forms, is highly developed, having a central pumping body, the heart, divided into two very distinct regions, a large sac-like muscular ventricle followed by a somewhat smaller thin-walled, globular chamber, the auricle. The direction of blood flow is regulated by a valve between the ventricle and the auricle. The heart lies in a cavity just in front of the adductor muscle. This, the pericardial cavity, is covered laterally by a thin membrane through which the strong pulsations of the heart, varying around seven per minute according to temperature, may be seen even after the severe shock of "opening" the oyster. Pulsation may continue for hours after the valves have been removed, under favorable conditions of humidity and temperature. This pulsation forces the aerated blood, a slightly gray, nearly clear fluid, into the auricles, on into the ventricle, and from thence out through the arteries to the body parts, passing over the digestive tract and gills before returning through the veins to the auricles. The blood passages between the arteries and veins are devoid of walls proper and partake of the nature of sinuses, thus bathing the tissues in the food and oxygen laden plasma which, at the same time, takes up carbon dioxide to be discharged when the blood passes through the gills, thus effecting complete respiration. As already indicated, great quantities of water are passed through the gills in the gathering of oxygen and the removal of gaseous matter.

Response To Stimuli

Sense organs are not so highly developed in the oyster as would be suspected in an animal otherwise highly developed. In the anterior region, near the gullet, there is a centralization of nervous tissue from which nerve fibres run to all parts of the body. These tissues thicken in several regions forming still smaller "ganglia" whose immediate connectives innervate the organs and surfaces near them. On the margin of the mantle, the thick membrane that envelopes the whole oyster, there project outward small tubercle or tentacles, bodies that are highly sensitive to touch. These bodies, normally extending out over the edges of the shells, receive impulses even of the most delicate nature, as a result of which the valves snap to upon the slightest provocation such as change in water pressure, density, rate of flow and, possibly, even change of light intensity. Such response offers a high degree of protection for the soft bodied animal. The tentacles are usually highly pigmented, being darker by far than oyster gray. No eyes are found in adult oysters though organs of sight are not uncommon in other species of molluscs.

Valves And Their Operation

Most noticeable in the organization of the oyster are the shells which, because of their concavity, offer ample space for the animal. These shells or valves are produced by the mantle which, as previously indicated, is a heavy glandular membrane surrounding the oyster, and which secretes a liquid limestone substance. This substance, upon hardening, becomes shell. Brooks, in his treatise, "The Oyster," tells of his observations of shell building upon glass inserted within the valves as follows: "At the end of twenty-four hours the glass was found to be covered by a transparent faintly brown film of thin gummy deposit, which exhibited no evidence of structure, and contained no visible particles of lime, although it effervesced when treated with acids, thus showing that it contained particles too small to be visible with a microscope. The gumming film is poured out from the wall of the mantle, and in forty-eight hours it forms a tough, leathery membrane fastening the glass over to the inside of the shell. At about this time the invisible particles of lime begin to aggregate and to form little flat

crystals, hexagonal in outline and about 1/2500 of an inch long. The crystals grow and unite into little bundles or groups, and new ones appear between the old ones, until at the end of six days, the film has completely lost its leathery character and has become stony, from the great amount of lime present in it. In three or four weeks the glass cover is completely built into the shell and can no longer be seen, and its place is only to be traced by its form, which is perfectly preserved upon the inner surface of the shell. When broken out it is found to be coated with a thick plate of white shell, which is beautifully smooth and pearly upon the side nearest the glass. Microscopic examination of this plate shows that it is made up of an immense number of minute crystals, packed and crowded together into a solid mass, without any regular arrangement. These observations show that the new layers are thrown off in the form of a gummy excretion from the mantle, with the lime in solution, and that the particles unite with each other and form crystals while the gum is hardening."

Since lime is deposited in successive films on the inside of the shells (see Figure 2, page 14), it would seem that the space occupied by the oyster would eventually be filled in to the exclusion of the oyster's body. This is not the case, however, for the mantle, when expanded, overhangs the edges of the concave shells and secretions are deposited thereon, thus constantly the shells are being opened as their edges grow apace.

The hinge mechanism consists of a ligament secreted by the anterior portion of the mantle and, as in the case of shell, this is not living tissue in the common sense of the words. Binding the two shells together it, at the same time, acts as a spring to force open the free ends of the shells. Since this ligament is not living substance and acts not only to hinge the shells but to keep their free ends apart, as well, it is apparent that the shells of an oyster would remain open indefinitely were not provision made for closing them. By means of the adductor muscle, a prominent and toughened mass just back of the heart, the shells may be closed tightly and strongly. It is this muscle (see Figure 1) that must be cut in the operation of oyster shucking. After it is severed, or upon death of the oyster, the shells open forthwith due to the hinge ligament. As would be expected, the adductor muscle is

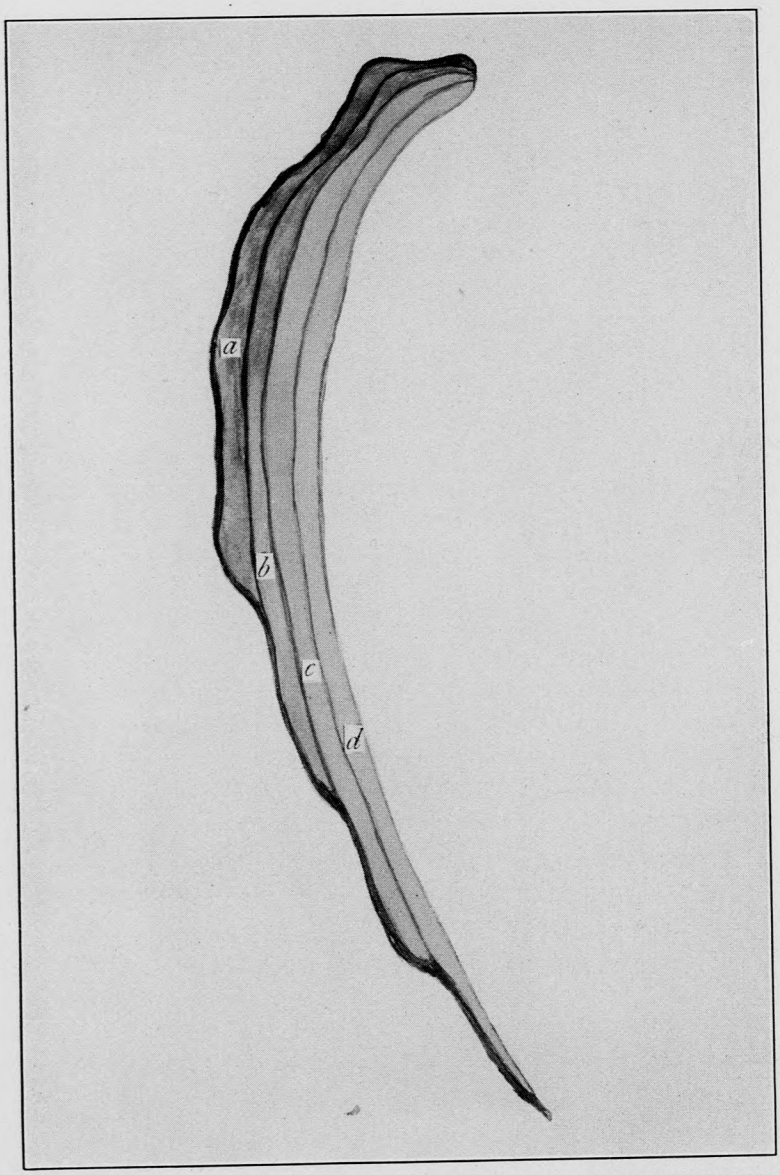


FIGURE NO. 2. DIAGRAMATIC SKETCH OF A LONGITUDINAL SECTION OF A SHELL FROM A FOUR-YEAR-OLD OYSTER, SHOWING ANNUAL DEPOSITS OF LIME.

a, Lime deposit first year; *b*, Lime deposit second year; *c*, Lime Deposit third year; *d*, Lime deposit fourth year.

attached to the shells at points where the greatest mechanical advantage is derived and, as the shells are extended in growth, the muscle attachments grow outward to retain their relative mechanical advantage. The outward movement is accomplished by an extension of the posterior section followed by absorption of the more anterior part. By breaking either shell lengthwise the progress of the outward migration of the muscle may be noted by the imbedded scar or pinkish area caused by the muscle imprint in the earlier stages.

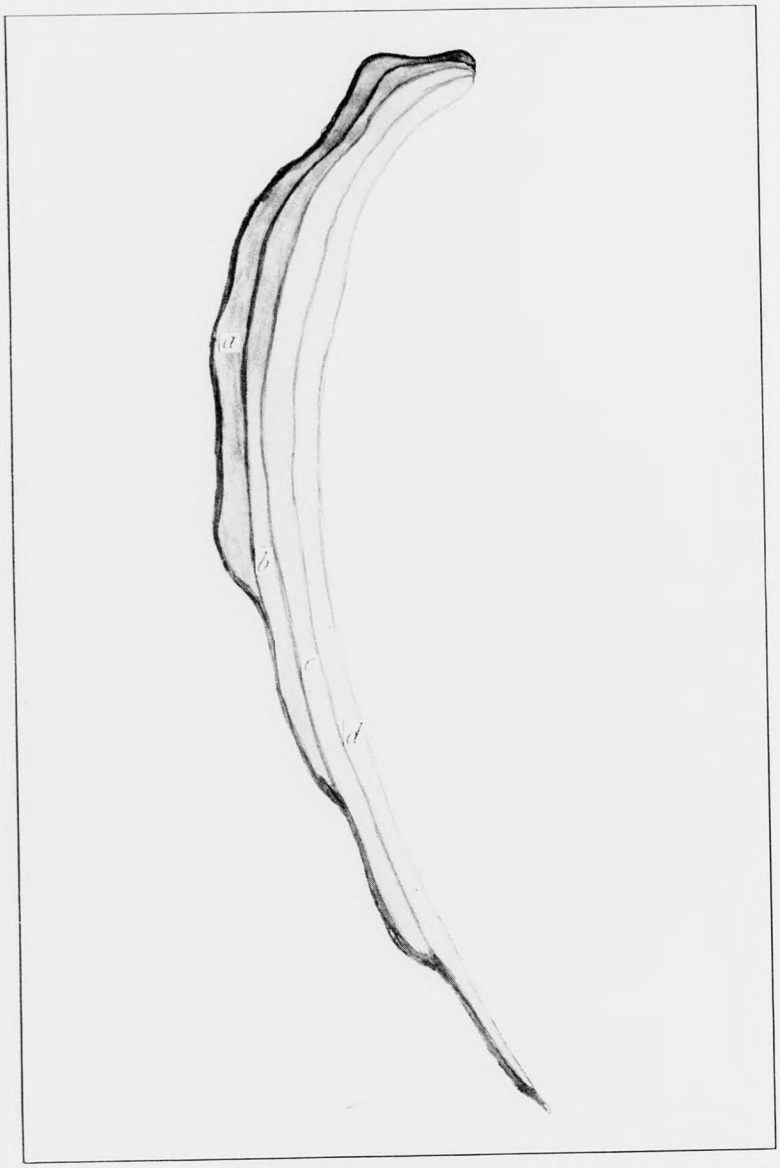
In their native state oysters keep their shells open nearly all the time, though frequently they close them for protection and to wash out foreign matter, excretions and fecal wastes. It is commonly held by oystermen that the oyster opens its shell, feeds and is active only on flood tide, but observations, by others as well as ourselves, have established that the shells are opened on both flood and ebb tides and at night as well as during the day, and that they stay open upward of three-fourths of the time. The activity of the gills, in respiration and feeding, however, varies with the temperature and, as would be suspected, lower thermometric readings tend to slow things up; Dr. Galtsoff, 1928, showed that at a temperature of 5° Centigrade or below oysters cease to feed.*

Out of the water oysters live for varying periods depending upon temperature and humidity. They may be kept long periods at very low temperatures while, conversely, they die within a few hours if the temperatures are extremely high. The animal does not cease its vital activities when removed from the shell and may remain alive for many hours, depending upon the physical conditions around it. The clear viscous fluid associated with shucked oysters of commerce is due to substances secreted and thrown off by the oysters themselves and is not a sign of decay as many purchasers of the raw commodity believe.

Reproduction

Maryland oysters have their sexes separate, differing thereby from the common European form, *Ostrea edulis*, each of which has two sex systems present in its body. The reproductive sys-

* "Experimental Study of the Function of the Oyster Gills and Its Bearing on the Problems of Oyster Culture and Sanitary Control of the Oyster Industry," Document No. 1035 of the United States Bureau of Fisheries, by Paul S. Galtsoff.



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tem, whether male or female, is located in the more bulky portion of the animal. Without the aid of the microscope the sex of an oyster can not be told though, when "ripe," the greater part of either sex system is plainly visible to the unaided eye, due to the distention caused by the vast number of germ cells present, or in the course of maturation. In this distended condition the reproductive system has somewhat the appearance of a tree, with the base of its trunk opening to the exterior in the region of the pericardium, and its branches anastomosing to the extent of covering nearly the entire lateral surface, there being one organ on each side of the oyster body. Oysters eject their reproductive cells directly into the open waters where, if the sperms and ova chance to come in contact with each other, fertilization ensues. The ejection of the germ cells is accompanied or, possibly, aided by sudden snapping of the valves which forces the water, loaded with cells, from around the body of the oyster and out into the open waters. At short intervals this operation is repeated, each time a small cloud, nearly cream colored, being produced, so abundant are the cells. At the Chesapeake Biological Laboratory it has been estimated that a single female contained 49,000,000 eggs—a very conservative estimate—while, in the male, the germ cells may be present in such prodigious numbers as to baffle ordinary methods of computation, hundreds of millions of them being found. In a five-inch oyster, whose gonads were not extraordinarily distended, some 900,000,000 spermatozoa were estimated to be present. Oyster eggs, when taken from the ovary, have somewhat the shape (See Plate I, Figure 2, page 17) of a grain of corn, but upon fertilization become round. The male cell (Plate I, Figure 3, page 17) is roundish with a tail-like appendage which drives it through the water; spermatozoa being mobile, while ova have not the power of movement. *Milt* and *spawn* are interchangeable terms applied to the genital products.

There is a marked correlation between spawning activities of oysters and the temperature of the water. In the Chesapeake region and, for that matter, through the greater part of the habitat of the species, oysters do not begin to spawn until the temperature reaches about 67° F. Optimum spawning takes place at about 76° F., while there is an almost complete cessation of spawning when the temperature of the water reaches 82° F.

Oysters with ripe gonads can be excited to spawn if, taken from waters ranging from 68° F. to 74° F., the temperature is gradually raised to the optimum degree or slightly above it. Knowledge of these facts contributes to a better understanding of the proper time to plant shells or other cultch in order to secure a maximum catch.

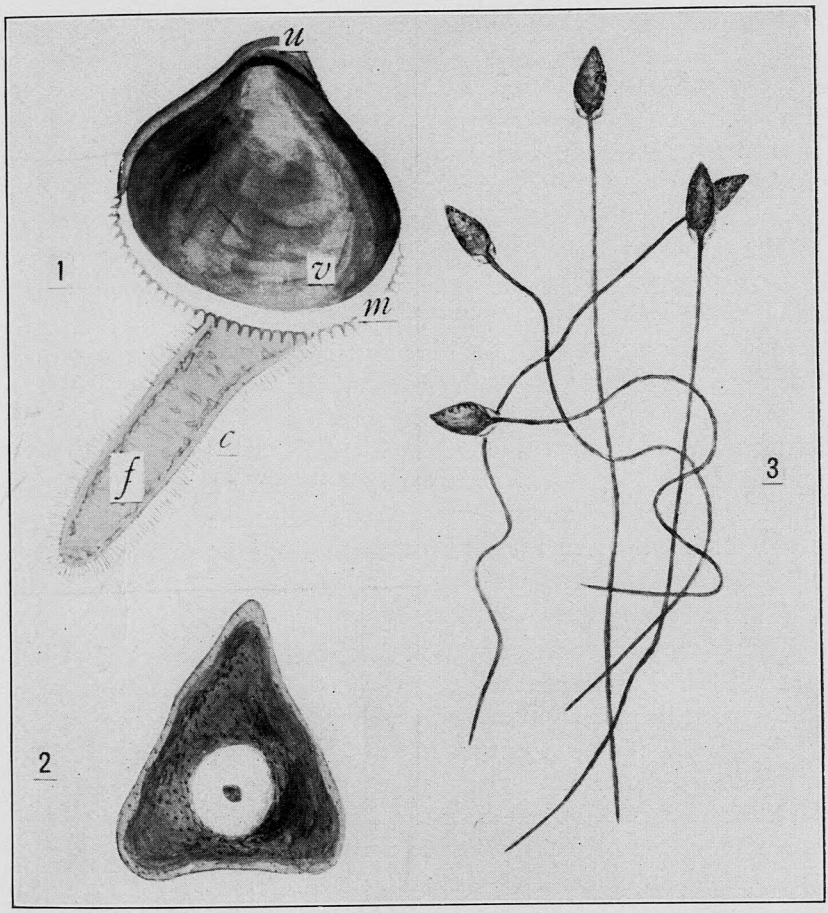

PLATE I.—1. FULLY DEVELOPED OYSTER LARVA, MAGNIFIED 160X.
c, Cilia; *f*, Foot; *m*, Mantle; *u*, Umbo; *v*, Shell or valve.

2. EGG OF OYSTER, MAGNIFIED 550X.

3. MALE CELLS OF OYSTER, ENLARGED 2000X.

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Oysters with ripe gonads can be excited to spawn if, taken from waters ranging from 68° F. to 74° F., the temperature is gradually raised to the optimum degree or slightly above it. Knowledge of these facts contributes to a better understanding of the proper time to plant shells or other cultch in order to secure a maximum catch.

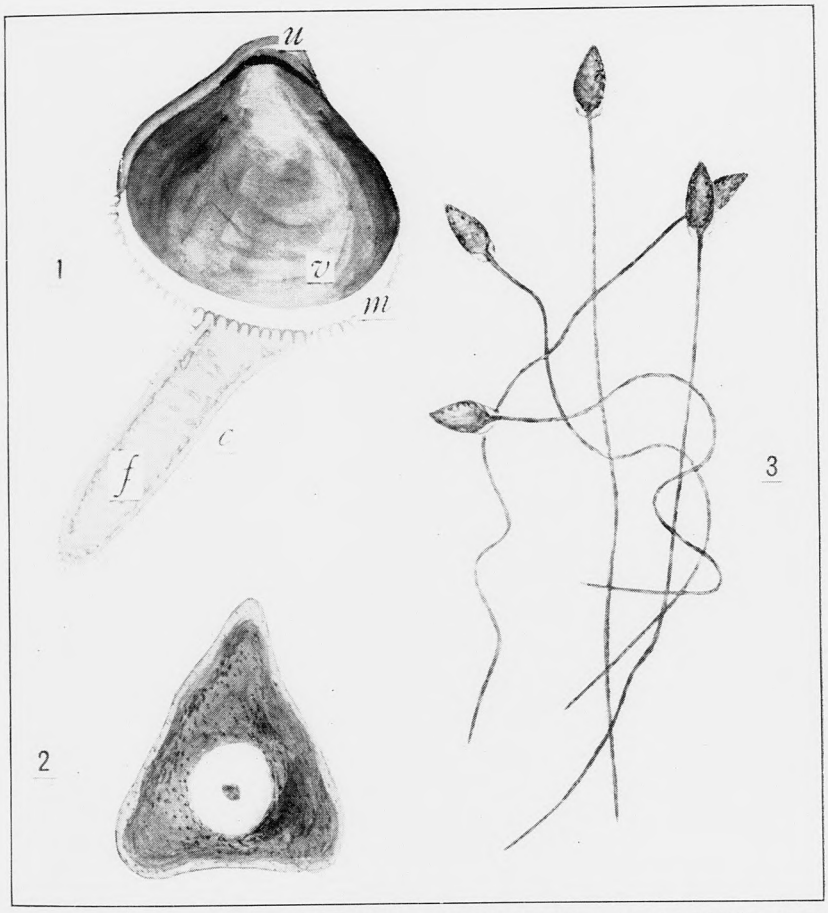


PLATE I.—1. FULLY DEVELOPED OYSTER LARVA, MAGNIFIED 160X.
c, Cilia; *f*, Foot; *m*, Mantle; *u*, Umbo; *v*, Shell or valve.

2. EGG OF OYSTER, MAGNIFIED 550X.

3. MALE CELLS OF OYSTER, ENLARGED 2000X.

Development

An egg allows but one sperm to penetrate and fuse nuclei with it, though not uncommonly many gather around and try to work their way in, partially gaining entrance in many instances. Rapid changes follow this initiation of development and in fifty-odd minutes the egg has changed its shape and become almost spherical. Following this by a few minutes there appears a knob-like protrusion on the surface of the egg which is followed shortly by the development of another, the pole cells. This early embryo, with its pole cells not far removed from each other, is now rather pear-shaped in outline and bilaterally symmetrical in form. Continuing development, the smaller end undergoes rapid cell division with subsequent additions to the number of cells. These small cells eventually nearly cover the larger end of the embryo whose cells, in the meantime, have divided also, forming, with the first layer, an embryo of two layers of cells the inner one of which, some three hours after fertilization, surrounds a cavity with an opening to the exterior. The cavity is known as the coelenteron, while the opening is known as the blastopore. The layers of the gastrula, as the embryo is termed at this stage of development, are known as the ectoderm and endoderm, the former being outside of the latter. At this time a circular tuft of hairs makes its appearance. These hair-like processes beat back and forth producing locomotion in the embryo which, from this time on, swims freely in the water though its development is nowise complete.

Following the developmental path of metazoan animals, a third layer of cells appears between the layers of the gastrula, and the embryo then flattens out considerably. On each side of the embryo a small plate appears and, with further secretion by the specialized cells or glands at the bases of the pads, these plates become the valves. While this is taking place the retractive ciliated rim, or velum, becomes more prominent and a protuberance from the region between the mouth and the anus develops into a foot for locomotor and other purposes. (The presence of a velum gave rise to the term *veliger* so generally used for molluscs in this stage of development.) By rapid development the shells grow to cover the entire embryo. The mouth, lengthening digestive tract, with its special organs, and anus have, by this time,

made their appearance. From near the base of the velum two ridges have developed before this, and from them, through growth, the mantle appears. During mantle formation and the period of shell extension the gill filaments arise as a row of delicate processes which, though simple at first, bend upon themselves so as to form a V-shape and then a W-shape structure. Spots apparently sensitive to light are present at this stage of development. Some four or five days time is necessary for the embryo to acquire full larval form and development, at which time it appears to be more clam-like than oyster-like in shape and general proportions. After an additional period of ten to twelve days the fully developed free swimming larval oyster (see Plate I, Figure 1) attaches itself to some clean hard object and thereafter leads a sedentary existence.

During the larval period oysters spend most of their time actively moving about and, during much of this period, they swarm at or near the top of the water. Probably the chief enemy during this period is a jelly-fish form known as the "sea-walnut," a Ctenophore. Not uncommonly thirty to sixty oyster larvae may be found in the stomodaeum or gut of these animals. They are, of course, destroyed by many other forms, as well as by physical changes in the water during this vulnerable period. Where there is an abundance of oyster brood stock larvae appear in surface waters in prodigious numbers. Indeed, not uncommonly upward of twenty thousand of them may be taken in a fifty-gallon surface sample of water in such a place as Tar Bay, Dorchester county. During the last few hours of their pelagic life however, they begin to search for a suitable surface to which they may attach themselves preparatory to settling down for life. When it is realized that the veliger at this time is about one-seventieth of an inch in its greatest dimension, the reason for selecting a smooth and very clean surface is understandable. Debris of any kind readily could preclude it or, by rolling under tidal influences, crush the larva easily. Then, too, hard objects available are those above the mud line of the bottom and for that reason serve the useful purpose of holding the tiny creatures up into oxygen and food-laden waters.

Setting Or Spat-Fall

The activities concerned with attachment of larvae to the surface of their choice are markedly similar throughout. With the foot protruded a larva scuds across objects, in effect feeling their surfaces out to ascertain their availability for spatting. As previously stated, of necessity the surface must be permanent, clean, hard and smooth, otherwise so delicate an organism would be subjected to many unconquerable hazards. When a favorable spot is selected the larva forces its adhesive foot out full length, about .22 m.m., and temporarily attaches its tip. Around this point as a centre it draws itself toward the attached foot, releases the end of the foot and attaches it elsewhere only to pull the body up to the tip of the foot again. Repeating this performance several times and describing circles of successively smaller radii in the course of the action, it finally comes to rest with the left valve against the object and inclined toward the opening of the valves. From a lobed gland (byssus) at the base of the foot secretions are produced at this time which, aided by the velum and the foot itself, are distributed in such a way as to cement, upon hardening, the oyster to the surface.* For the whole operation about one quarter of an hour is required. Henceforth, the oyster, in this stage termed *spat,* remains stationary and depends upon the tides to deliver its food and other necessities of life.

Not all clean hard surfaces attract larval oysters alike. Experimental work with such materials as brick-bats, oyster shells, broken glass, chips of various kinds of wood, coal slag, pebbles, and other things suspended in wire baskets, side by each, over a bed of oysters at Spencer's Wharf, in the Patuxent River, produced varying results. Using all the materials in a clean state and at a time when many mature oyster larvae were known to be abundant in the water, shells proved to be far more preferable than glass, slag, pebbles, brick-bats and chips. In many cases the shell attracted 100% more oysters than did glass, the second in importance. Brick-bats, slag, pebbles and chips followed in order of efficiency.

* For further reference in connection with this interesting activity see "The Attachment of Oyster Larvae" in Biological Bulletin, Vol. XLVI, No. 3, March, 1924, New Jersey, Thurlow C. Nelson.

Growth And Age

Growth, after the spat-fall, is very rapid though varying according to environmental conditions, such as rate of tide flow, food and oxygen content, abundance of set or extent of crowding, and the like. If isolated and suspended where full tide-play on the spat is possible growth is phenomenally rapid; as much as one-half to three-quarters of an inch per month. Spat that attached themselves to a boat's bottom in late June were found, in the Choptank River region, to be two and one-quarter inches in length on October fifth. However, under normal conditions at the bottom in that section spat reach, in the same period of time, barely an inch in length, on an average. Oysters ranging from spat sizes up to dimensions of an inch and a half, or up to three inches, are known as *seed*. Such oysters are used for planting purposes, especially on private grounds. Except for certain very limited beds in Maryland, known as seed areas, oysters may not be captured, legally, under three inches in length. The seed areas are resorted to only during very short periods in early spring.

Oysters in Maryland may spawn at one year of age, though at this early period they produce comparatively small numbers of germ cells. In the case of the oyster whose numbers of eggs were estimated, heretofore referred to, the age was four years. Others have been known to spawn at nine years of age though, it is believed, these very old ones spawn less prolifically as time goes on. The length of time an oyster will grow has not been determined, but there is evidence to the effect that growth may continue for ten or eleven years. During the second winter, under normal conditions, most of the juvenile oysters reach legal size for capture, or become merchantable size, three inches in length. At two years of age Chesapeake oysters are three and a half to four inches in length while the greatest length recorded by us, for Maryland oysters, is nine and five-eighths inches.

Enemies

In Maryland waters, oysters, once they have attached themselves and started their sedentary existence, have few enemies. In the lower bay, rarely above Hoopers Straits and St. Jerome's Creek, and on the beds of the coastal waters of Worcester county,

a species of snails—*Urosalpinx cinereus*—bores in a peculiar fashion through the shells of oysters, paralyzes the adductor muscle, and, feeding on the prey, destroys it. As many as thirty-five thousand bushels of oysters have been destroyed in the State by this pest in one year. However, comparing that loss, which is much more severe in seed stock than in adults, with the output of the Commonwealth, the "screwborer" is a pest of little importance. Its greatest destruction is done in waters of higher salinity, thus in our neighboring states its presence may be felt acutely, especially on beds constantly used in oyster planting, and on natural bars. Star-fishes, the bane of the more northerly oyster farmers' existence, do not thrive in Maryland waters. How fortunate local oystermen are because of the distribution of this animal may be realized from the fact that a single oyster producing corporation in Rhode Island, the Narragansett Oyster Company of Providence, mopped up and destroyed, at great expense, 1,259,955 pounds of this pest in a single year—1929—and even then reported considerable damage to its crop. The pest, by exerting a steady, even, though not powerful stress on the shells, at length overcomes the muscle holding the valves of the oyster together and, everting its stomach, surrounds the bivalve and digests it. A few fin fishes destroy oysters, the black-drum being an outstanding offender. We have taken from the stomach of one fish thirty-one oysters just after they were consumed. However, there are few drums, so that though schooling drum occasionally are reported as having made marked inroads on small areas, little injury comes from that source. Hardheads, toads, burr fish and others are frequently charged with oyster destruction, but investigations of their digestive tracts fail to incriminate, by the large. It seems very true that fewer natural enemies of the oyster exist in the waters of the State than elsewhere in the habitat of the species, thus affording another explanation of the exceeding potentialities of the Chesapeake.

OYSTER PRODUCTION

As indicated previously, oysters are marine creatures. They are not uncommonly found in waters ranging from 1.005 salinity to 1.025 or, in other words, from such waters as those at the head of the Chesapeake Bay, in the Man O' War Shoals and Tolchester Beach region, as well as sea water proper. Some would claim that oysters will not grow in the sea. It is a common experience at Ocean City, Maryland, to find oysters attached to fishing gear placed in the ocean, while investigations made by ourselves have shown recent spat, as well as older oysters, in several places along the coast. However, the most heavily producing natural beds in Maryland have been in the Chesapeake proper; though quantitative production cannot be correlated with the salt content of the water, since highly productive beds are found both in the upper and lower extremes of the Bay. Oyster farming is the exclusive practice in the Sinepuxent Bay, along the coast, and this in spite of the fact that bottoms are less well adapted and physical conditions are poorer, by and large, than in many big areas of the Chesapeake.

Natural Beds Or Rocks

"Natural rocks", "natural beds" and "natural bars" are terms applied interchangeably to certain bottom areas—some 215,000 acres in Maryland according to the survey of 1906-12 by the Maryland Shell Fish Commission—of varying sizes, upon which oysters thrive under natural conditions. Heretofore it has been pointed out that oysters require currents, solid foundations for attachment, and food-laden waters for purposes of security and rapid growth. Through long periods of time oysters were dispersed from one point to another by currents, tides and winds, where such favorable conditions as enumerated above existed, until the areas available were seeded. Once the spat had gained foot-hold they throve, reproduced and extended their group upward and laterally. When the original spat chanced to fall upon areas of projecting rocks, boulders, or stones cropping out from the bottom, an oyster colony, "reef", "bed" (See picture page 24), "rock" or "bar", was soon built, for available round

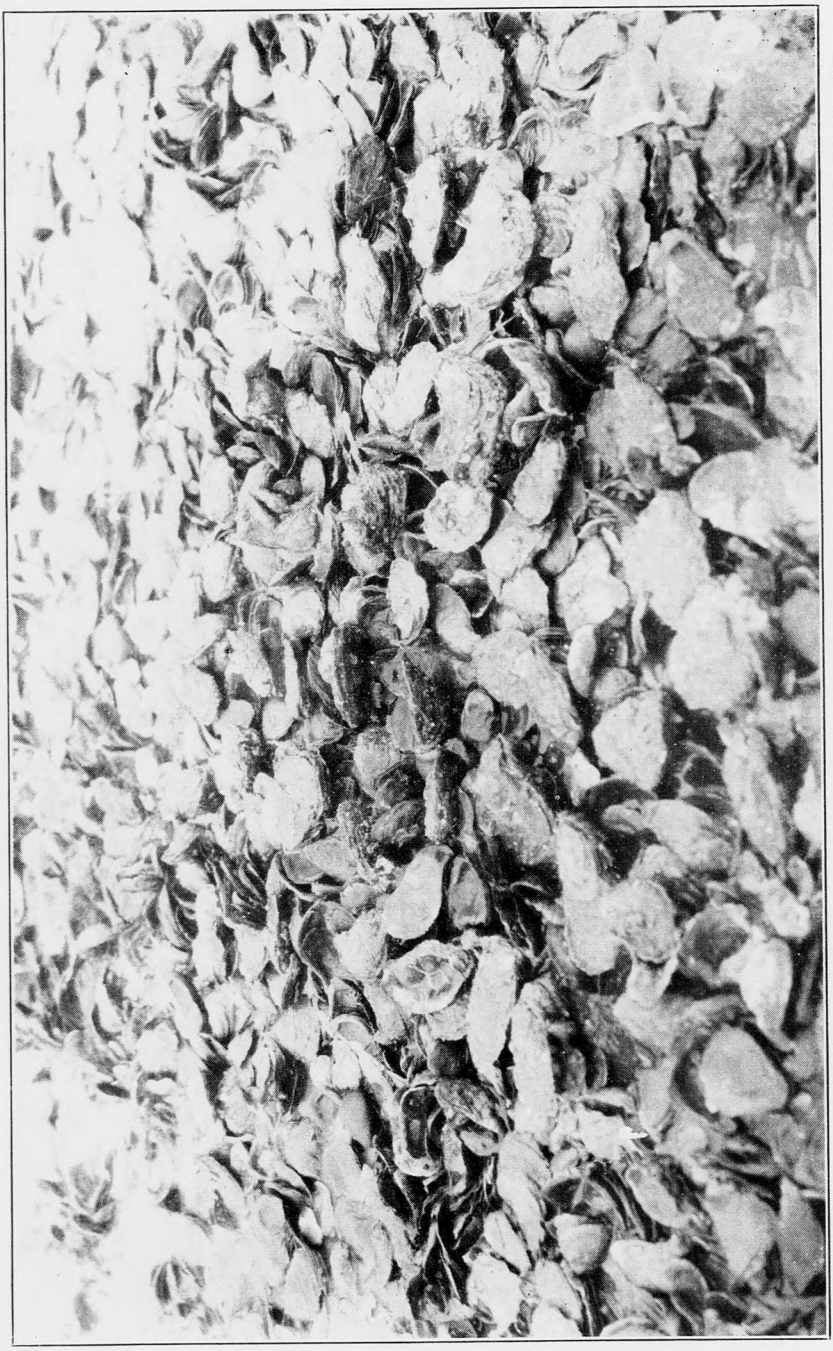
A NATURAL OYSTER BED IN THE CHESAPEAKE SHOWING CULTCH, SPAT AND MATURE OYSTERS.

A NATURAL OYSTER BED IN THE CHESAPEAKE SHOWING CULTCH, SPAT AND MATURE OYSTERS.

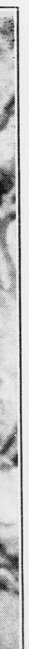
about were surfaces to which the progeny could readily attach themselves. In cases where a small object became populated by spat, extension of the bed was not such an easy matter, though many of the best and largest bars in Maryland apparently were started in that way. These required longer periods of time for, without hard sub-structure, they had to build from the center outward and depend upon death of the old oysters, to which veligers persistently attach themselves, to supply the hard materials, shells, for building purposes. When man first started to tap the oyster resources in the Chesapeake, he found that many of the natural beds had sub-strata of shells several feet thick and one, the Tea Table, near the head of the Bay, where salinity fluctuations are more devastating, extended from the bottom up to the level of mean-low-tide. As indicated, this bed, in common with many others, was built by virtue of the fact that young forms freely attached themselves to adult oysters and, because of their numbers and the fact that they project still further out into the food and oxygen supplied water, competed with the old ones for the essentials of life and, finally, smothered and starved the old ones to death. In turn, the younger ones were destroyed by such a process but, always, the shells were left to build substantial strata and extend the bed laterally, making available cultch for generations to come. It is obvious, then, that rock ledges and bars, in the nautical sense, were not essential to the building of our great natural oyster beds. Indeed, the few beds developed upon rocks and stones of which there are few in the Chesapeake, have not been the greatest producers, for the oyster-man works upon them as a last resort, since taking oysters from them is difficult and expensive, because dredges and tongs do not function well upon them, and there are hazards, because of "hangs" and jams on the bottom, to craft, apparatus and man.

In the legal sense, natural bars are held to be such areas as were developed under natural conditions, only, and which now produce enough oysters to afford a livelihood for fishermen resorting to them or, on the other hand, areas having once been productive, and now giving indication of becoming productive again.

Abundance of food for oysters, as well as other favorable factors, exists in many places where oysters did not become



A NATURAL OYSTER BED IN THE CHESAPEAKE SHOWING CULTCH, SPAT AND MATURE OYSTERS.



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established and develop natural beds. In fact, food is very abundant on tide swept, muddy bottoms which, in the main, could not and cannot now support young oysters without smothering them under ooze, shifting debris, or silt. Where this type of bottom has clay mixed with it to somewhat a doughy consistency beds may be developed by shell planting. On bottoms with a consistency in between these extremes larger seed oysters may be transplanted and cultured with success. The Sinepuxent Bay is successfully oyster farmed on just such bottoms as these. In the Chesapeake the outstanding beds are found on bottom areas located between the channel proper, with its soft bottom, and the sandy sloping shore areas. These beds vary from a few hundred feet to as much as a mile-and-a-quarter in width, and their depth under water ranges from five to fifty feet. In the Chesapeake natural beds do not extend to the normal tide level, but in its tributaries and along the coastal waters they range up as far as the mean high tide and may be exposed to the air for long periods due to tidal fluctuations.

Depleted and Barren Bottoms

Under natural conditions oysters established bars, extended these bar boundaries according to the environmental fitness, and maintained the bars by virtue of the fact that upon the death of the older oysters their shells became fine bar-building cultch materials. However, with the development of the oyster industry, and the removal of adult oysters in greater and still greater numbers, the brood stock constantly was being diminished. With this taking place, fewer oysters were left to die of senility and other causes, thus no longer were shells being added to maintain the cultch supply. More than this! Since young oysters attach themselves so tightly to old shells it is impossible in many cases to remove all the shell from the oyster before marketing. In the early days of the industry there was little desire to remove these shells at all for they helped to fill the measure, or "tub", so commonly used in buying stock. Not only were the oysters being taken, then, in progressively greater numbers, alone a depleting activity, but the natural bars were being destroyed through the removal of shells. By the decade of 1880-1890, when the peak of intensified fishing had been

reached, the effect of diminished brood stock and reduced cultch material began to show up, and from that time until very recently there has, with exceptional years, been a constant diminution in the volume of the oyster business, and bed after bed of natural oyster producing bottom has been reduced to a point where either it does not produce at all or, if still producing, its output is but a semblance of one time high productivity. An illustration of this is found in the formerly highly productive Tangier Sound with its annual output of some 4,000,000 bushels and its present yearly production of less than 100,000 bushels of oysters. In the Tangier Sound the vast "Great Rock", once productive of oysters celebrated for their abundance, size and flavor, now produces only a few hundred bushels of oysters yearly, and hardly justifies the effort required to capture them. The oyster trade name, "Tangier", has been lost to the industry. Such a bar is said to be *depleted.* Harris' Rock, in the same body of water, once highly productive, has not produced in the past decade enough oysters even to invite inspection by the dredgers who sail by it weekly. The bed was resorted to persistently and worked so intensively that it is entirely unproductive, *or barren.*

A few of the natural bars of the Bay are producing heavily at this time in spite of the great inroads that have been made on them, a testimony to the richness of the waters over them and to their favorable location. By the large, however, the products of these beds were not so highly desired as were those from beds made barren elsewhere. That is to say, the better the quality of the oyster the more intensively its beds were fished and the sooner they became exhausted.

Oyster Farming

Oyster farming in many ways is similar to agricultural pursuits in that it involves: firstly, property rights in the underwater lands (leases); secondly, investments in seed and efforts at culture, and, thirdly, it requires planning and study, giving opportunity to match wits with the elements, as well as a chance for the individual to reap from his own sowing.

Much of the bottom leased in Maryland is used for the purpose of holding oysters for short periods from early season, when oysters are cheap, until the rigors of winter slow up oystering

on the natural bars and the prices soar upward. This is not farming. Because of the fact that bottoms permitted by law to be leased are, by the large, not well suited to that purpose, comparatively little farming is done in Maryland, this in spite of the fact that thousands of acres of potentially productive bottoms are lying fallow with no immediate hope for their development because of the fixed policy of management which now rests in the hands of legislative bodies. Good farming practice requires that seed oysters be planted on suitable bottoms at a given quantity per acre, depending upon the size of the seed and the nature of the bottom. Seed running seven or eight hundred to the bushel should require from 300 to 400 bushels to the acre planting, depending upon the time the oysters will be allowed to remain on the bottom or the size it is desired to produce. Oyster seed may run as high per bushel as 2000 or more. Larger sizes are preferable, however, for Maryland plantings.

In planting oysters it is not conducive to growth to use over and over again the same ground, for enemies thrive under such conditions and a general unwholesome condition may arise as a result of the practice. If the bottoms used tend toward softness it is often essential that the crop be transplanted to avoid having it destroyed by sinking below the food and oxygen level. From two to three years are required to produce a crop. Seed running 800 to the bushel will, under favorable conditions, yield from two to three bushels for each one planted. Seed stock sells from thirty-five to sixty cents per bushel, and the bulk of the supply at this time comes from Virginia and North Carolina. However, efforts are being made to restore the great seed areas once so productive in Maryland.

On particularly favorable bottoms shells may be planted for seed production purposes. Before shell planting is done it is essential to know that sufficient brood stock exists in the general section so that free swimming oysters will be available and assure a catch. Very little shell planting is done on private grounds in Maryland since such holdings, for reasons set forth, are not well suited for development. If the bottom is soft, shells will sink into it while, if sandy, small oysters are precluded from the shells because of the shifting surface.

THE OYSTER FISHERY OF MARYLAND

Since oysters are produced upon beds over which the depth of water ranges from a few inches down to fifty or sixty feet, quite diversified apparatus and methods of capture have been evolved. Among the Indians and the early settlers wooden forks were used, and oysters were gathered from shallower beds only. However, with depletion along the shore line, it became more and more difficult to obtain a catch, thus apparatus to reach the supply known to be in deeper waters was essential. First came simple hand rakes, made of iron, very similar to the common garden rake but wider and with longer teeth and with a pole for a handle. Following this there was developed crude tongs, which lead to the modern "oyster tongs", and the *dredge*.

In water not more than ten feet deep hand tongs render good service. Beyond that depth dredges are more efficient, though patent tongs are used in several sections. In Maryland waters sharp lines of demarcation are placed around the dredging grounds, and only by use of tongs may oysters be taken elsewhere. Generally speaking, shallower tributaries are set aside for tongers, and the Bay, with the deeper tributaries, is resorted to by dredgers, all boundaries being fixed by law.

Tongs are operated from boats, usually small ones of thirty foot length or less, and the boat is anchored while the oysters are being tonged from the bottom. When the anchor is thrown overboard a short cable is payed out, and, after the tonger has worked all the way around his craft raking the bottom thoroughly, further cable is released and the boat drifts over a new area, thus avoiding frequent anchor heaving. In dredging, sail boats only are allowed to operate. The craft tack back and forth over the beds dragging the dredges on the bottom. A dredge ordinarily is drawn from the bottom by power, a special deck motor being used. Tonging has the advantage of inexpensive equipment, though it is greatly restricted and is extremely hard work.

Tongs and Tonging

The picture on page 31 shows oyster tongs being used. A single part of the appliance consists of a metal framework and a handle. The framework is made of iron, and consists of a bar

of some forty inches in length, bearing teeth on its lower face. Along this bar there are five iron rods, forming the head, which parallel it, and whose ends terminate in a slightly curved upright from the end of the main or toothed bar, forming with it a concavity. The width of the metal framework is from five to ten inches, as desired. By placing a wooden handle or stale at right angles in each of two such metal pieces and riveting or pinning these handles together at the point of maximum efficiency—usually less than one-third the distance from the toothed bar to the end of the stales—scissors-like oyster tongs are produced. The teeth on each bar are set inward. When the stales are closed the metal-work forms a basket-like affair with the teeth crossed below it. As indicated, tongs work scissors-fashion. By alternately drawing them open and closing them, the teeth gathering hard objects into the basket, it requires only four or five "licks" to fill a bushel measure if oysters are abundant. Such abundance on natural bars, however, rarely exists at present. On private beds an expert workman may handily tong from ten to fifteen bushels of oysters an hour, though the work is very laborious. Workmen rarely engaged themselves in such operations for more than five hours, the remainder of the day being spent in "culling off" his load.

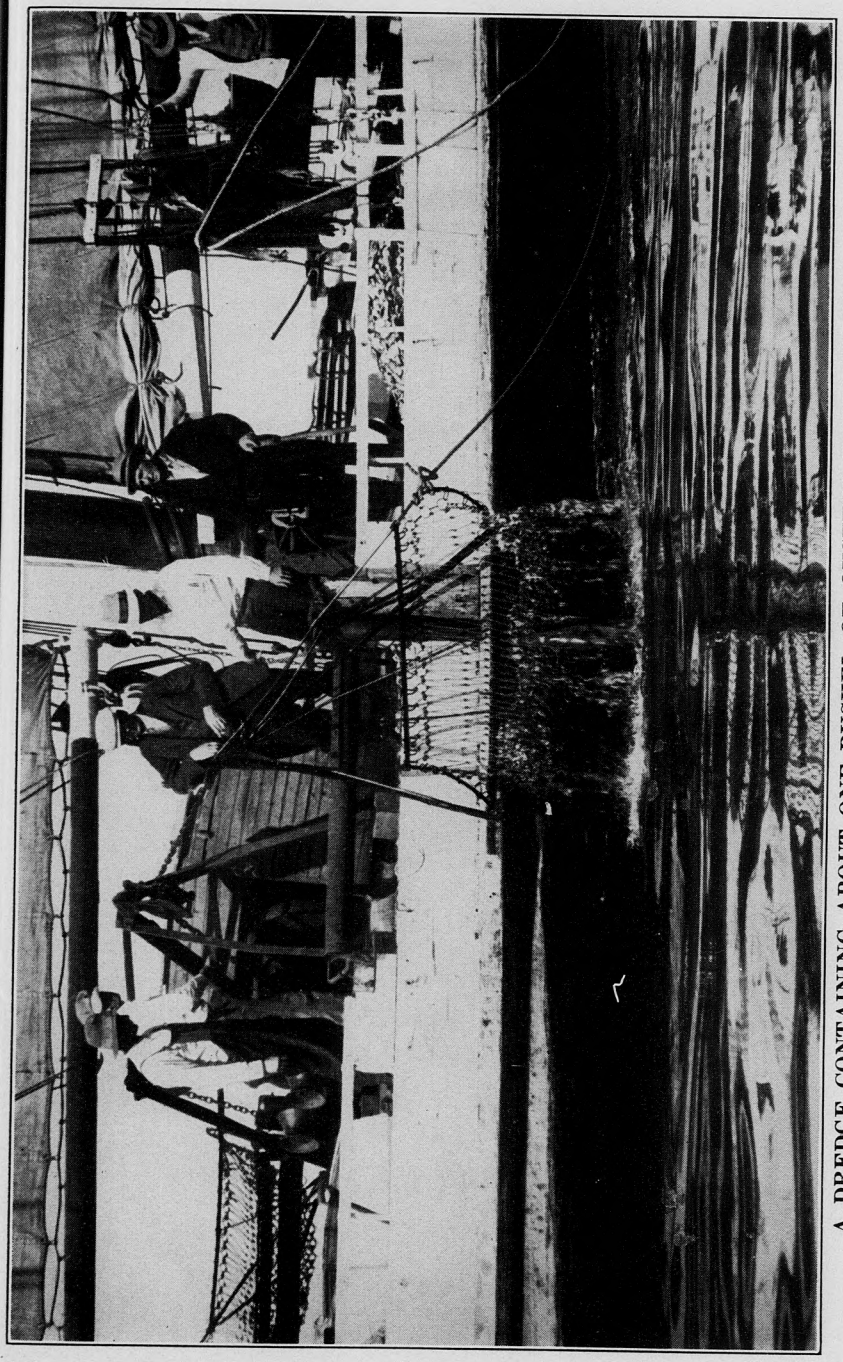
Certain localities in Maryland permit the use of patent tongs on natural bars. Except that their stales are sturdier, shorter and of iron instead of wood, and that the basket feature of the tongs is much larger, patent tongs are made along the same lines as ordinary hand tongs. They are used in waters of depths which commonly employ dredges but, because of police difficulties, in which dredge boats are not allowed to operate. Patent tongs are lowered and raised by windlasses either by hand or by the power of a deck engine, and they cannot be used from a moving craft. In the upper ends of the iron handles there are holes for the ropes, one each, by which the tongs are operated. A chain link on one handle engages the head of its mate while being lowered, and releases it when the tongs come to rest upon the bottom. By pulling up and down on a line connected to the two lines from the ends of the handles, the teeth of the tongs are worked toward each other and finally closed with the oysters raked into the tongs' head. As many as a bushel of oysters may be brought up from the bottom at a time with this type of gear.

TONGERS AT WORK ON TOLLEY'S POINT BAR, MOUTH OF SEVERN RIVER. NOTE CULLER AT WORK SORTING THE OYSTERS, RETURNING SHELLS AND SMALL OYSTERS TO THE BARS.

Dredges and Dredging

Dredging is the common, general and most practical method of harvesting oysters wherever the water is deep enough to operate. Since this is the most efficient method of taking oysters from the bottoms, dredging areas in the Chesapeake were the first to become depleted and barren. Very little tonging ground has been made barren, though much of it has been resorted to by oystermen since the earliest days of the industry, or about one century ago.

A dredge consists of two iron triangular structures, stoutly made and united at their apexes, the lower one of which has a blade-like base of heavy construction and carries stubbed teeth. These triangular structures are held apart securely by two curved bars, one on each side of the dredge, running from the apexes of the base angles of the triangles. From the two bases, or cross bars, and the curved part of the dredge the bag is suspended, the bag being one-half of cotton rope and the other half of iron rings and chain points. Rope is used to make the bag more flexible. It is meshed. The triangle bearing the teeth, usually wider and longer than the other one, is the lower part of the dredge. Its cross bar is set at an angle that assures maximum attack for the teeth which it bears. The chain part of the bag is attached to this bar so that metal rather than cotton rope is exposed to the rugged conditions of the bottoms. Dredges run in size from so called "hand scrapes", with a capacity of one bushel, to immense sizes with a sixty-inch tooth bar and in which ten or more bushels of oysters may be taken at one haul. In Long Island Sound dredges of far greater capacity are used on private beds. Usually the larger dredges are braced with metal bars and rods in several places so that they may withstand "hangs" and other violent strains while being dragged on the bottom. Oft times, and especially with lighter dredges, a "wing" is used to hold the dredge on the bottom. This consists simply of a thin sheet of metal tied in the upper triangle of the framework in such fashion as to cut downward in the water as the dredge moves forward. The "wing" or "devil dive" was outlawed by the 1927 session of the Legislature of Maryland, however.



A DREDGE CONTAINING ABOUT ONE BUSHEL OF OYSTERS BEING HAULED ABOARD.

Only sail boats are permitted by law to operate dredges on the public beds of Maryland. While power boats are far more effective than dredge boats, they are not permitted since it is recognized that in a period of a few years the remaining productive beds would be stripped bare of oysters and the industry brought to ruin, should the season not be shortened and other limitations effected. Sail craft, depending upon winds, of course cannot be systematic and exact, and because of their use, oysters, for seeding purposes, are left on the bottoms to a certain extent. The heavy dredges are operated by windlasses driven by donkey engines on the decks of boats. The type of boat used in dredging varies from the small skip-jack to the coastal trading schooner, though the favorite Chesapeake type is the bugeye.

In operating a dredge (see accompanying illustration) something must be known of the type of bottom—hard, soft, rocky and the like—the depth of water and the speed of the boat, and even when these factors are established experience in company with a veteran dredger helps greatly. Not all expert watermen are good dredgers. Generally speaking, it requires for dredging purposes a line some five or six times as long as the depth of the water on the bed. If too much line is payed out the teeth dig deeply into the bottom and the bag becomes filled with matter other than oysters, and, when hauled aboard, makes for more difficult washing and culling. Conversely, with too little rope payed out the angle of attach for the teeth is such as to cause the dredge to ship from place to place and make only an occasional dig in the bottom. However, by increasing the speed of the boat in the first case and retarding it in the second the efficiency of the dredge may be increased.*

* For further information on dredging see "Some Principles of Oyster Dredging" by J. Richard Nelson, Agricultural Experiment Station, New Brunswick, N. J.

See other book here

MARKETING OYSTERS

After oysters are taken from public beds usually they are sold to buyers who transport them to the shucking and steaming houses in so-called "buy-boats". Most commonly these boats, now largely driven by power, are either owned or chartered by dealers or managers of houses where oysters are prepared for the market. Some buyers, however, purchase oysters outright and freight their cargoes to one of the three main oyster centers—Baltimore, Cambridge and Crisfield—where they visit the dealers and attempt sales to an advantage. Where boats are chartered to buy and run oysters their masters are paid according to agreement, either by the load or so much per bushel, the distance freighted being a factor. Some independent buyers attempt to sell their stock on the open market to the highest bidder, but this method meets with marked success only when the product is very scarce.

Oyster cargoes are unloaded at the oyster house by a hoist operating a metallic measure, hand, horse or engine powered, according to the volume of business. By wheelbarrows, and in some cases by machine driven cars or endless chains, they are transported to spacious bins from which they are delivered in turn to the shucker or, in the case of canning, to the steam oven.

Canned Oysters

Baltimore gave the world its entire supply of canned oysters for a long period of time after "cove oysters", as they were known, were introduced in 1820. Until quite recently the United States continued to supply nearly all canned oysters, though since the World War Japan has made big inroads on this truly American industry, that nation not having experienced such diminution in harvests as have we in this country. Canning extended from Baltimore to several Eastern Shore points but, with the decline of the natural supply, the business has diminished until at the present time Maryland no longer leads in the canning of oysters. Mississippi, for instance, has developed a greater number of canneries and at present is doing a greater

volume of business in this field. The quality of the Chesapeake oyster and its scarcity make it difficult for the local canneries to compete with similar organizations located in several states where oysters, for sufficient reason, are sold at considerably lower prices.

Located along water fronts, oyster canneries have either steaming rooms or iron steam closets into which cars, made of open iron work and bearing fifteen to twenty bushels of oysters, are rolled. After five minutes of steam pressure, more or less according to the type of oyster, on these bivalves they are ready to be shucked; that is, they have their shells gaping open, because of the action of the heat on the adductor muscle, causing it to relax. Rolled from the "steamer" into the shucking room the oysters are opened, largely by women and older girls, directly from cars. The oysters are placed in seive-like buckets and the worker is paid for his work by the pound of dry meats. Then the oysters, after thorough washing, are placed in cans, sealed and further cooked by steam. The kettle into which the basket of canned oysters is lowered for "processing" is made of iron and is heated by steam. Very little liquor is put into the cans with the oysters. The volume of oysters placed in a can varies from four or five ounces up to twenty ounces.

Raw Oysters

The bulk of Maryland's oyster supply finds its way to the market in a shucked or raw state. To remove oysters from their shells there is required considerable skill, whatever the method. From the bin oysters are placed in stalls assigned to individual shuckers who proceed to open them. Two methods of shucking are employed. In one method, "stabbing", a knife with a thin double edged blade set in an egg-shaped wooden handle is used. By exerting steady pressure along the outer border, accompanied with short turns of the handle back and forth, the blade enters the oyster and, after cutting the adductor muscle near one shell, forces the shells open to a degree wherein the hinge ligament is broken and the two valves are separated, one bearing the oyster meat. Cutting the muscle near the other shell the meat is freed to be thrown into a measuring cup. The motions of dexterous hands in stabbing oysters are very rapid. Highly expert

shuckers employ only five motions to the oyster, and may open as many as twenty gallons per day if big and fat stock is used and strenuous effort is made. Average workers, men and women, do not shuck over ten or eleven gallons of meat—dry measure is demanded—per day. The pay runs about thirty cents per gallon.

In the second method of opening raw oysters the thin outer edges, "bills", of the oysters are knocked off by means of a hammer and block, and the knife is inserted into the opening to cut the muscle. Stabbing is the more general, cleaner and faster method of shucking oysters. When oysters are in good condition they yield one gallon of solid matter to the bushel.

Shell accumulate around the shuckers and are conveyed to the shell piles outside of the house by means of wheelbarrows. In the larger houses provision is made by which the shells drop into troughs and are carried to the piles automatically. The shells formerly were a by-product of the oyster industry, but today they are a very vital part of the industry itself.

The shucked oysters are, in most cases, washed by means of improved machinery and fresh water of known purity. After this, air under pressure may or may not be passed through the water in which the oysters are placed to further clean and remove foreign matter. At this point the product is ready to be placed in cans. The shuckers grade the oysters as they open them, placing the largest ones, *Counts,* in one container, the middle sized ones, *Selects,* in another, and the smallest oysters, *Standards,* in still another container. The cans used vary in size, the three most commonly used being of one, three and five gallons capacity, respectively. No liquor is placed in the cans which, when filled, are securely covered and packed in crushed ice in such position that all of their surfaces are in contact with it. Usually the smaller cans are iced in barrels for shipment while five gallon cans are placed in separate boxes built for the purpose, though this is a matter of preference on the part of the individual oyster dealer.

Raw oysters are shipped from Maryland to every part of North America, and several packers of Chesapeake oysters fill orders from Europe. In these long hauls it is necessary to re-ice once or twice while the oysters are in transit. While the flavor of

the commodity is not fully as good upon arrival at far distant points, oysters are delivered in a sanitary and wholesome condition. Properly iced and temperature controlled this sea-food keeps for weeks. In a frozen condition preservation for months is possible without deterioration.

Shell Stock

Oysters in the shell are not shipped to a very great extent from the Chesapeake though the entire supply from the Sinepuxent Bay, until recently, was marketed in the shell. Such stock is used, by the large, for raw bar trade in restaurants and on the half shell in hotels and cafes. Sinepuxent shell stock is marketed as "Chincoteagues", from the name of an island in Virginia and an ocean inlet in that Commonwealth whose tidal action supplies the salt of coastal bays of Maryland. The most celebrated raw-bar oysters of the Chesapeake in Maryland are the "Tangiers", produced in Somerset county. Like the Chincoteagues, these oysters have a decided tang of the sea and are particularly well-flavored and succulent, comparing favorably with the Lynnhaven oysters of Virginia and even the most celebrated of all raw-bar types, the "Bluepoints" of Long Island. Less than 5% of Maryland's oysters are shipped in the shell.

Oysters to be shipped in the shell are graded into two classes, primes and culls, the latter running to large or small sizes as the market desires. They are packed in barrels made for shipping purposes which, typically, hold three bushels, though barrels of ten pecks capacity are used in some places. Burlap bags are used for shipping purposes to a limited extent. Oyster barrels are made in the usual way except that they are strongly reinforced. In shipping the barrel is not headed, but, instead, covers of burlap are used. No ice is used in the barrel during transportation, though in very long hauls refrigerated cars are employed.

Shells

As previously set forth, shells are transported either by wheelbarrow or by endless belts, or scrapes, to the shell pile. This pile or mound is of immense proportions, having several hundred

thousand bushels at the end of the season, in big shucking houses. In the early days of the industry the accumulated shells were a problem to the management of the houses since they were of little use except to fill up holes in roads and, to a very limited extent, to be burned for lime. However, with the good roads impetus of the 1890-1900 period, and the building up of a chick grit (egg production purposes) demand at the close of that decade, shells began to take on value and have risen in price until they are now worth seven cents the bushel. Thus the shell pile today is guarded, since in many cases it represents the greater part of the profits from the business. Not infrequently one hears a dealer say, "If I can clear my shell pile I will be pleased."

The owners of shell piles in Maryland have three possibilities of sales, to wit: manufacturers of chick grit, manufacturers of shell lime, and to the State or private individuals desiring to plant them for oyster culture purposes. For road building purposes shells are rarely used now. The use of shells by either method is interesting but the details cannot be given here. Suffice it to say that shell lime for agricultural purposes brings prices ranging from $4 per ton to $8 per ton, and that normally acid soil requires approximately one ton to the acre. Chick grit, for the manufacturing of which elaborate machinery and expert supervision are necessary, sells from $12 to $20 per ton and retails at two cents per pound. European demands for chick grit are met in no small part by the shell piles found in Maryland. The use of shells in developing oyster beds has been discussed elsewhere. In this connection it should be repeated that shells are the most efficient materials known for the restoration of the natural oyster bars. The Conservation Department is empowered by law to take, without cost, 10% of the shells produced by the oyster dealers of Maryland. Such shells are, of course, used as cultch for oyster bed restoration work.

REHABILITATION OF MARYLAND'S OYSTER INDUSTRY

That the Chesapeake Bay has suffered a great decline in its oyster production is generally conceded by the oystermen and by the public. Equally true is the fact that consumers, as well as the fishermen, are anxious to have the waters produce as heavily as they did years ago. Scientists have made thorough studies of the physical and biological conditions of the waters, and have collected evidences of the fact that this vast body of water is essentially the same today as it was back in the "eighties" when Maryland, in its heyday of oyster production, dominated the oyster market by producing just about as many of these bivalves as did all the rest of the world. Why, then, it is natural to ask, is not the great volume of oyster food available in the Bay converted into oyster meat to feed a growing population in need of, in addition to the rich food matter contained in oysters, the invaluable disease preventing salts carried therewith? When it is realized that four ordinary acres of oyster ground can be made to produce upward of four thousand bushels of oysters in three years (4,000 gallons or 36,000 pounds of pure food) and that a like acreage of first rate farm land sowed to forage crops will, on an average, produce only one steer in the same period of time which will barely dress, bone and rough parts included, seven hundred pounds, is there not more than a challenge to effect restoration? Unquestionably there is an obligation on the part of the citizenry to restore natural production on the thousands of acres of depleted and barren bottoms. Undoubtedly the obligation goes further than that and directs that natural methods should be assisted and improved upon until unprecedented yields are realized. Just such efforts are being made by the Conservation Department of Maryland at this time, though its resources, not the least of which is public interest constructively reflected, are entirely too limited.

Concerning Leasing

The problem of restoration of oyster bars and the rehabilitation of Maryland's industry, now fourth in rank among the states of the Union which it once easily lead, would seem simple since

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